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Prospects for RAON Experiments with the KISTI-6 Supercomputer

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The RAON heavy-ion accelerator facility in Korea is entering a new era of precision nuclear physics experiments. These include studies on exotic nuclei near the proton drip line. One recent large-scale computational achievement using the KISTI-5 supercomputer (Nurion, 25.7 PF) was the theoretical and simulation-based support for the determination of nuclear charge radii in neutron-deficient sodium isotopes. This project required extensive *ab initio* nuclear structure calculations and advanced reaction modeling. The calculations pushed Nurion to its computational limits. In addition, Geant4-based beam simulations were also carried out on Nurion to support the RAON experiments. These simulations provided key insights into beam dynamics and detector performance.

The KISTI-6 supercomputer, providing 600 PF GPU-accelerated performance, will create unprecedented opportunities for the RAON experimental program. The massively parallel architecture and high memory bandwidth of GPU nodes will enable large-scale coupled-cluster and nuclear lattice effective field theory (NLEFT) simulations. It will also support higher-precision Monte Carlo analysis and more accurate modeling of nuclear charge radii in isotopes far from stability. We anticipate that this computational leap will not only refine the theoretical interpretation of experimental data but also guide detector design, optimize beam time usage. It will significantly improve predictive accuracy for upcoming measurements beyond the current sodium isotope study.

The synergy between RAON's experimental capabilities and the KISTI-6 supercomputer will advance nuclear structure research. It will set new benchmarks at the exascale level. It will also pave the way for discoveries in both fundamental nuclear properties and applications in astrophysical modeling.

Paper submission Plan

Yes

Best Presentation

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